PB-239 551

BUTTERNUT LAKE, ASHLAND AND PRICE COUNTIES, WISCONSIN

Pacific Northwest Environmental Research Laboratory

Prepared for:

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Wisconsin Department of Natural Resources

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT

ON

BUTTERNUT LAKE

ASHLAND AND PRICE COUNTIES

WISCONSIN

EPA REGION V

WORKING PAPER No. 34

WITH THE COOPERATION OF THE

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

AND THE

WISCONSIN NATIONAL GUARD

OCTOBER, 1974

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F O R E W O R D

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Wisconsin Department of Natural Resources for professional involvement and to the Wisconsin National Guard for conduct of the tributary sampling phase of the Survey.

Francis H. Schraufnagel, Acting Assistant Director, and Joseph R. Ball of the Bureau of Water Quality, and Donald R. Winter, Lake Rehabilitation Program, provided invaluable lake documentation and counsel during the Survey. Central Office and District Office personnel of the Department of Natural Resources reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper series.

Major General James J. Lison, Jr., the Adjutant General of Wisconsin, and Project Officer CW-4 Donald D. Erickson, who directed the volunteer efforts of the Wisconsin National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

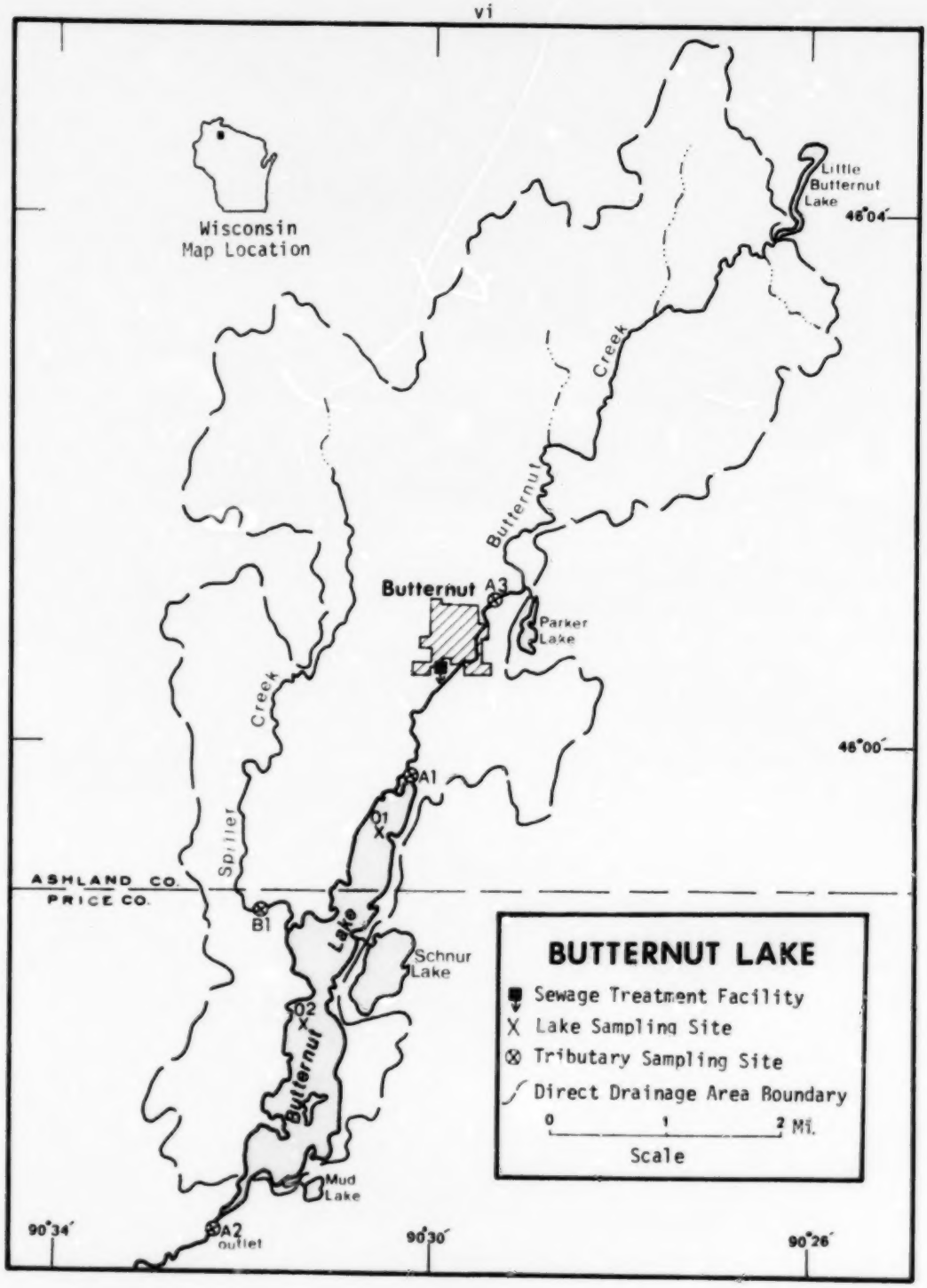
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF WISCONSIN

LAKE NAME	COUNTY
Altoona	Eau Claire
Beaver Dam	Barron
Beaver Dam	Dodge
Big Eau Pleine	Marathon
Browns	Racine
Butte des Morts	Winnebago
Butternut	Price, Ashland
Castle Rock Flowage	Juneau
Como	Walworth
Crystal	Vilas
Delavan	Walworth
Eau Claire	Eau Claire
Elk	Price
Geneva	Walworth
Grand	Green Lake
Green	Green Lake
Kegonsa	Dane
Koshkonong	Jefferson, Rock, Dane
Lac La Belle	Waukesha
Long	Price
Middle	Walworth
Nagawicka	Waukesha
Oconomowoc	Waukesha
Okauchee	Waukesha
Petenwell Flowage	Juneau
Pewaukee	Waukesha
Pigeon	Waupaca
Pine	Waukesha
Poygan	Winnebago, Waushara
Rock	Jefferson
Rome Pond	Jefferson, Waukesha
Round	Waupaca
Shawano	Shawano

LAKE NAME	COUNTY
Sinnissippi	Dodge
Swan	Columbia
Tainter	Dunn
Tichigan	Racine
Townline	Oneida
Trout	Vilas
Wapogassett	Polk
Wausau	Marathon
Willow	Oneida
Winnebago	Winnebago, Fond Du Lac, Calumet
Wisconsin	Columbia
Wissota	Chippewa
Yellow	Burnett


Wisconsin
Map Location
Little
Butternut
Lake
46°04'
Butternut
Creek
Butternut
A3
Parker
Lake
Spiller
Creek
46°00'
A1
O1
ASHLAND CO.
PRICE CO.
B1
Lake
Schnur
Lake
O2
Butternut
Mud
Lake
90°34'
A2
outlet
90°30'
90°26'
BUTTERNUT LAKE
Sewage Treatment Facility
Lake Sampling Site
Tributary Sampling Site
Direct Drainage Area Boundary
0
1
2 Mi.
Scale

BUTTERNUT LAKE

STORET NO. 5509

I. CONCLUSIONS

A. Trophic Condition:

Survey data and the records of others indicate that Butternut Lake is eutrophic.

B. Rate-Limiting Nutrient:

Algal assay results and lake data indicate that Butternut Lake was nitrogen limited during the period of Survey sampling.

C. Nutrient Controllability:

1. Point sources--It is calculated that during the sampling year, the total phosphorus load to Butternut Lake from all sources just exceeded that proposed by Vollenweider (in press) as "dangerous"; i.e., a eutrophic rate (see page 14). Of that load, it is estimated that the Village of Butternut contributed about 34%.

In the following table, the total phosphorus loading rates that can be achieved by specified levels of phosphorus removal at the Butternut treatment facilities are shown and compared to Vollenweider's suggested loading rates.

	Total P Loading Rate	
% P Removal	lbs/acre/yr	$g/m^2/yr$
Existing	5.7	0.64
70	4.3	0.49
80	4.1	0.46
85	4.0	0.45
90	3.9	0.44
100	3.7	0.42

	$g/m^2/yr$
Vollenweider:	
"Dangerous"	0.62
"Permissible"	0.31

A final discharge permit has been issued to the Village of Butternut by the Wisconsin Department of Natural Resources. Included in the conditions of the permit is a requirement for either 85% phosphorus removal or elimination of effluent discharge to the lake.

It will be noted that either of these phosphorus removal options will reduce the loading rate to less than the dangerous or eutrophic rate and should at least result in a reduction of the incidence and severity of nuisance algal blooms in Butternut Lake. On the basis of Vollenweider's models, a significant improvement in the trophic condition of the lake would be predicted.

2. Non-point sources (see page 14)--The phosphorus exports of Butternut and Spiller creeks were similar to those of Wisconsin streams studied elsewhere in the Chippewa River drainage.

In all, non-point sources are estimated to have contributed about 60% of the total phosphorus load to Butternut Lake during the sampling year.

II. INTRODUCTION

Butternut Lake is located in a sparsely populated area on the Ashland-Price County line in northwestern Wisconsin. Topography in the watershed is primarily rolling glacial terrain and is characterized by mixed conifers and deciduous forest with limited farming activity except for dairying.

The primary uses of the lake are boating and fishing. Game fish present include muskellunge, northern pike, walleyes, largemouth bass, and panfish; commercial boating facilities are available, and public access is provided (Anonymous, 1972).

III. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry*:

1. Surface area: 1,006 acres.
2. Mean depth: 13.9 feet.
3. Maximum depth: 32 feet.
4. Volume: 14,017 acre/feet.
5. Mean hydraulic retention time: 146 days.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area†	Mean flow†
Butternut Creek	27.2 mi^2	28.3 cfs
Spiller Creek	8.9 mi^2	9.7 cfs
Minor tributaries & immediate drainage -	8.1 mi^2	10.5 cfs
Totals	44.2 mi^2	48.5 cfs

2. Outlet -

Butternut Creek	45.8 mi^2††	48.5 cfs

C. Precipitation†††:

1. Year of sampling: 35.8 inches.
2. Mean annual: 32.9 inches.

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* Dept. of Natural Resources lake survey map.
† Drainage areas are accurate within ±0.5%; mean daily flows are accurate within ±40%; mean monthly flows are accurate within ±35%; and normalized monthly flows are accurate within ±35%.
†† Includes area of lake.
††† See Working Paper No. 1, "Survey Methods".

IV. LAKE WATER QUALITY SUMMARY

Butternut Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Except for the first sampling period, samples for physical and chemical parameters were collected from a number of depths at two sampling stations (see map, page vi). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the two sites for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was collected for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll *a* analysis. The maximum depths sampled were 10 feet at station 1 and 20 feet at station 2.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake was essentially well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

FALL VALUES

(11/04/72)

Parameter	Minimum	Mean	Median	Maximum
Temperature (Cent.)	3.3	3.7	3.8	4.0
Dissolved oxygen (mg/l)	10.0	10.7	10.3	12.4
Conductivity (μmhos)	95	98	98	100
pH (units)	6.7	6.9	6.9	6.9
Alkalinity (mg/l)	26	30	28	34
Total P (mg/l)	0.056	0.066	0.069	0.075
Dissolved P (mg/l)	0.045	0.051	0.054	0.057
NO_2 + NO_3 (mg/l)	0.180	0.187	0.180	0.200
Ammonia (mg/l)	0.110	0.123	0.120	0.130
		ALL VALUES		
Secchi disc (inches)	30	40	36	60

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/26/72	1. Fragilaria	3,442
	2. Anabaena	978
	3. Dinobryon	870
	4. Flagellates	507
	5. Polycystis	254
	Other genera	1,268
	Total	7,319
08/25/72	1. Flagellates	905
	2. Melosira	882
	3. Synechococcus	860
	4. Polycystis	566
	5. Cyclotella	543
	Other genera	1,040
	Total	4,796
11/04/72	1. Fragilaria	602
	2. Dinobryon	331
	3. Flagellates	281
	4. Melosira	221
	5. Scenedesmus	110
	Other genera	593
	Total	2,138

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/26/72	01	10.4
	02	20.0
08/25/72	01	2.3
	02	1.4
11/04/72	01	2.5
	02	3.9

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.031	0.182	5.4
0.006 P	0.037	0.182	5.7
0.012 P	0.043	0.182	5.8
0.024 P	0.055	0.182	5.8
0.060 P	0.091	0.182	5.8
0.060 P + 10.0 N	0.091	10.182	49.6
10.0 N	0.031	10.182	12.9

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates the potential primary productivity of Butternut Lake was moderate at the time the sample was collected (about 55% of the Wisconsin lakes studied had lower control yields). Also, the lack of significant change in yields with increased levels of orthophosphorus, until nitrogen was also added, indicates the lake was nitrogen limited

at the time the sample was collected (note that the addition of only nitrogen resulted in a yield significantly greater than the control yield).

There was a 25% loss of inorganic nitrogen in the sample between the time of collection and the beginning of the assay; however, nitrogen limitation is also indicated by the lake data; i.e., inorganic nitrogen to dissolved phosphorus ratios were less than 8 to 1 on all occasions, and nitrogen limitation would be expected.

D. Trophic Condition:

Survey data indicate Butternut Lake is eutrophic. Of the 44 Wisconsin lakes on which sampling was completed, 29 had less mean total phosphorus, 31 had less mean dissolved phosphorus, 22 had less mean inorganic nitrogen, and 22 had greater mean Secchi disc transparencies.

Survey limnologists noted that Butternut Lake clarity varied from "poor" to "very turbid," and an algal bloom was observed in June. Also, in a 1970 Department of Natural Resources report (McKersie, et al., 1970), it is noted that Butternut Lake "...has experienced heavy algae blooms".

Butternut Lake is listed in "Problem Lakes in the United States" (Ketelle and Uttormark, 1971).

V. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Wisconsin National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for the high runoff months of April and May when two samples were collected. Sampling was begun in September, 1972, and was completed in August, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Wisconsin District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were calculated using mean annual concentrations and mean annual flows. Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the mean annual concentrations in Spiller Creek at station B-1 and the mean annual ZZ flow. In the nutrient loading tables that follow, the loads attributed to Butternut Creek are those measured at A-1 minus the loads attributed to the Village of Butternut wastewater treatment facility.

Since the Village of Butternut declined participation in the Survey, nutrient loads from there were determined indirectly; i.e., the loads in Butternut Creek at station A-1 just below the treatment facility, minus the loads in the creek at station A-3, just above the facility, equal the loads from the facility.

The Butternut Cheese Dairy Products Company waste discharges are not believed to affect Butternut Lake. Can washings are discharged to a ridge and furrow ground disposal system, whey is hauled to a gravel pit, and sanitary wastes are discharged to the municipal system.

A. Waste Sources:

1. Known municipal -

Name	Pop. Served	Treatment	Mean Flow (mgd)	Receiving Water
Village of Butternut	453*	Secondary & Pond	0.190**	Butternut Creek

2. Known industrial** -

Name	Product	Treatment	Mean Flow (mgd)	Receiving Water
Butternut Cheese Dairy Products Co.	Cheese	Land	?	-

* 1970 Census.
** McKersie, 35 al., 1970.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Butternut Creek	1,820	31.7
Spiller Creek	780	13.6
b. Minor tributaries & immediate drainage (non-point load) -	850	14.8
c. Known municipal -		
Village of Butternut	1,970	34.3
d. Septic tanks* -	160	2.8
e. Industrial -		
Butternut Cheese Dairy Products Company	No discharge	
f. Direct precipitation** -	160	2.8
Total	5,740	100.0

2. Outputs -

Lake outlet - Butternut Creek 5,540

3. Net annual P accumulation - 200 pounds

* Estimated; 9 resorts and 160 dwellings on lakeshore (see Working Paper No. 1).
** See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/ yr	% of total
a. Tributaries (non-point load) -		
Butternut Creek	50,400	41.1
Spiller Creek	24,510	19.7
b. Minor tributaries & immediate drainage (non-point load) -	26,650	21.4
c. Known municipal -		
Village of Butternut	6,280	4.4
d. Septic tanks* -	5,880	5.6
e. Known industrial -		
Butternut Cheese Dairy Products Company	No discharge	
f. Direct precipitation** -	9,690	7.8
Total	123,410	100.0

2. Outputs -

Lake outlet - Butternut Creek 117,920

3. Net annual N accumulation - 5,490 pounds

* Estimated; 9 resorts and 160 dwellings on lakeshore (see Working Paper No. 1).
** See Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	lbs P/mi^2/yr	lbs N/mi^2/yr
Butternut Creek	67	1,853
Spiller Creek	88	2,754

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

	Total Phosphorus		Total Nitrogen	
Units	Total	Accumualted	Total	Accumulated
lbs/acre/yr	5.7	0.2	122.7	5.5
grams/m^2/yr	0.64	0.02	13.7	0.6

Vollenweider loading rates for phosphorus (g/m^2/yr) based on mean depth and mean hydraulic retention time of Butternut Lake:

"Dangerous" (eutrophic rate)	0.62
"Permissible" (oligotrophic rate)	0.31

VI. LITERATURE REVIEWED

Anonymous, 1972. Wisconsin lakes. Publ. #218-72, Dept. of Natural Resources, Madison.

Ball, Joseph, 1974. Personal communication (resorts and dwellings around Butternut lake). Dept. of Natural Resources, Madison.

Ketelle, Martha J. & Paul D. Uttermark, 1971. Problem lakes in the United States. EPA Water Poll. Contr. Res. Ser., Proj. 16010 EHR.

McKerzie, Jerome R., Robert M. Krill, Charles Kozel, & Danny J. Ryan; 1970. Upper Chippewa River pollution investigation survey. Dept. of Natural Resources, Madison.

Vollenweider, Richard A., (in press). Input-output models. Schweiz. A. Hydrol.

TRIBUTARY FLOW INFORMATION FOR WISCONSIN 3/30/74

LAKE CODE 5509 BUTTERNUT LAKE

TOTAL DRAINAGE AREA OF LAKE 45.90

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
5509A1	27.20	14.00	12.00	23.00	84.00	62.00	39.00	20.00	13.00	18.00	20.00	20.00	15.00	28.34
5509A2	45.40	23.00	20.00	40.00	146.00	104.00	68.00	35.00	23.00	31.00	34.00	33.00	25.00	48.50
5509H1	8.96	5.50	4.60	7.40	29.00	22.00	13.00	6.60	4.20	5.80	6.60	6.60	5.20	9.71
5509Z7	9.64	5.90	5.00	8.00	32.00	24.00	14.00	7.20	4.60	6.40	7.00	7.00	5.60	10.54

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 45.80
SUM OF SUB-DRAINAGE AREAS = 45.80

TOTAL FLOW IN = 583.20
TOTAL FLOW OUT = 582.00

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
5509A1	9	72	33.00	25	20.00				
	10	72	36.00	14	31.00				
	11	72	33.00	12	68.00				
	12	72	23.00	9	25.00				
	1	73	15.00						
	2	73	12.00	3	18.00				
	3	73	110.00	3	15.00	11	90.00		
	4	73	86.00	7	60.00	21	99.00		
	5	73	140.00	5	210.00	20	49.00		
	6	73	36.00	24	22.00				
	7	73	12.00	22	9.00				
	8	73	12.00	26	11.00				
5509A2	9	72	56.00	25	34.00				
	10	72	64.00	14	56.00				
	11	72	60.00	12	110.00				
	12	72	36.00	9	40.00				
	1	73	27.00						
	2	73	21.00	3	31.00				
	3	73	190.00	3	26.00	11	155.00		
	4	73	140.00	7	100.00	21	170.00		
	5	73	220.00	5	340.00	20	79.00		
	6	73	60.00	24	37.00				
	7	73	20.00	22	15.00				
	8	73	20.00	26	18.00				

TRIBUTARY FLOW INFORMATION FOR WISCONSIN 9/30/74

LAKE CODE 5509 BUTTERNUT LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
5509R1	9	72	11.00	25	6.60				
	10	72	10.00	14	9.60				
	11	72	9.60	12	21.00				
	12	72	7.90	9	8.60				
	1	73	4.40						
	2	73	3.40	3	5.20				
	3	73	35.00	3	4.80	11	28.00		
	4	73	29.00	7	20.00	21	33.00		
	5	73	50.00	5	76.00	20	18.00		
	6	73	12.00	24	7.20				
	7	73	3.80	22	2.90				
	8	73	3.90	26	3.50				
550927	9	72	12.00	25	7.40				
	10	72	11.00	14	10.00				
	11	72	10.00	12	23.00				
	12	72	8.50	9	9.30				
	1	73	4.90						
	2	73	3.80	3	5.50				
	3	73	36.00	3	5.20	11	31.00		
	4	73	33.00	7	23.00	21	37.00		
	5	73	54.00	5	84.00	20	20.00		
	6	73	13.00	24	80.00				
	7	73	4.30	22	3.30				
	8	73	4.40	26	3.90				

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/09/30

550901
45 59 30.0 090 30 30.0
BUTTERNUT LAKE
55 WISCONSIN

11EPALES 2111202
3 0010 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/26	13 00	0000	18.1	9.1	60	105	8.00	40	0.050	0.060	0.037	0.027
72/08/25	11 25	0000			32	75	6.70	12	0.090	0.210	0.091	0.062
	11 25	0004	19.7	4.2		75	6.75	21	0.060	0.210	0.090	0.059
	11 25	0009	19.5	4.2		73	6.78	22	0.070	0.220	0.096	0.058
72/11/04	11 10	0000			30	100	6.70	33	0.190	0.130	0.059	0.045
	11 10	0004	3.3	10.2		100	6.80	34	0.200	0.130	0.056	0.045
	11 10	0010	3.4	12.4		98	6.90	32	0.200	0.130	0.060	0.045

DATE FROM TO	TIME OF DAY	DEPTH FEET	32211 CHLRPHYL A UG/L
72/06/26	13 00	0000	10.4J
72/08/25	11 25	0000	2.3J
72/11/04	11 10	0000	2.5J

J VALUE KNOWN TO BE IN ERROR

15 A

STORET RETRIEVAL DATE 74/09/30

550902
45 57 30.0 090 31 12.0
BUTTERNUT LAKE
55 WISCONSIN

11EPALES 2111202
3 0008 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/26	13 20	0000	18.9	10.2	50	105	8.40	39	0.040	0.060	0.038	0.027
72/08/25	11 00	0000			30	80	6.90	25	0.090	0.290	0.093	0.060
	11 00	0004	19.9	4.9		78	6.80	22	0.090	0.270	0.116	0.060
	11 00	0015	19.8	4.4		78	6.80	19	0.100	0.270	0.205	0.054
	11 00	0020	19.2	4.0		80	6.80	18	0.110	0.340	0.251	0.058
72/11/04	11 00	0000			36	95	6.90	28	0.180	0.120	0.071	0.054
	11 00	0004	3.9	10.6		95	6.90	28	0.180	0.110	0.069	0.057
	11 00	0015	4.0	10.0		95	6.90	26	0.180	0.120	0.072	0.056

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/26	13 20	0000	20.0J
72/08/25	11 00	0000	1.4J
72/11/04	11 00	0000	3.9J

J VALUE KNOWN TO BE +/- ERROR

STORET RETRIEVAL DATE 74/09/30

550903
45 56 00.0 090 33 00.0
BUTTERNUT LAKE
55099 WISCONSIN

11EPALES
4

2111202
0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	0066[illegible] MG/L P
72/06/26	13 45	0000	20.6	6.4	60	105	7.10	24	0.060	0.070	0.035	0.025
72/08/25	10 45	0000	19.7	5.0	36	83	6.90	23	0.120	0.310	0.093	0.063
72/11/04	10 50	0000	3.8	10.3	30	100	6.90	26	0.180	0.120	0.075	0.055

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/26	13 45	0000	11.8J
72/08/25	10 45	0000	6.7J
72/11/04	10 50	0000	4.4J

21

J VALUE KNOWN TO BE LESS ERROR

APPENDIX C

TRIBUTARY DATA

STORET RETRIEVAL DATE 74/10/02

5509A1 LS5509A1
46 00 00.0 090 30 00.0
BUTTERNUT CREEK
55139 7.5 KENNEDY
I/BUTTERNUT LAKE
XING SE OFF CO HWY B BELO BUTTERNUT STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/25	18 00		0.140	0.900	0.220	0.073	0.092
72/10/14	14 10		0.087	0.900	0.115	0.033	0.066
72/11/12	09 17		0.100	0.780	0.052	0.020	0.039
72/12/09	14 10		0.260	0.630	0.160	0.035	0.075
73/01/21	09 20		0.390	1.100	0.200	0.048	0.072
73/02/03	15 10		0.294	0.690	0.189	0.058	0.090
73/03/11	09 55		0.357	0.520	0.189	0.046	0.085
73/04/07	14 05		0.085	0.520	0.028	0.015	0.030
73/04/21	08 35		0.040	0.910	0.034	0.020	0.050
73/05/05	08 30		0.027	0.630	0.020	0.015	0.035
73/05/20	14 30		0.026	0.720	0.076	0.024	0.045
73/06/24	09 45		0.081	1.100	0.096	0.050	0.080
73/07/22	09 25		0.061	0.780	0.078	0.052	0.085
73/09/26	14 45		0.096	2.000	0.190	0.086	0.105

STORET RETRIEVAL DATE 74/10/02

L5550-42
45 36 39.0 090 42 14.0
BUTTERNUT LAKE
55 7.5 KENNEDY
O/BUTTERNUT LAKE
CO HWY H XING SW END OF LAKE
TIERALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/25	18 45		0.190	1.250	0.120	0.063	0.110
72/10/14	14 35		0.240	1.000	0.132	0.052	0.092
72/11/12	09 32		0.181	0.960	0.060	0.048	0.077
72/12/04	14 30		0.200	0.820	0.066	0.034	0.063
73/01/21	09 40		0.252	0.840	0.063	0.035	0.060
73/02/03	15 27		0.240	0.900	0.030	0.032	0.057
73/03/03	10 15		0.240	0.800	0.012	0.025	0.045
73/04/07	14 20		0.154	0.560	0.015	0.019	0.040
73/04/21	08 45		0.130	2.300	0.078	0.023	0.050
73/05/05	08 45		0.044	1.400	0.052	0.019	0.045
73/05/20	14 35		0.013	0.670	0.036	0.013	0.035
73/05/24	10 00		0.021	1.200	0.066	0.015	0.040
73/07/22	09 45		0.025	1.200	0.046	0.013	0.065
73/08/26	15 15		0.026	1.260	0.066	0.017	0.045

STORET RETRIEVAL DATE 74/10/02

5509A3 L55509A3
46 01 00.0 090 29 30.0
BUTTERNUT CREEK
55 15 BUTTERNUT
1/BUTTERNUT LAKE
CO HWY F BRDG ABV BUTTERNUTSTP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/25	17 50		0.110	0.800	0.098	0.026	0.035
72/10/14	14 00		0.120	0.800	0.105	0.012	0.034
72/11/12	09 10		0.091	1.380	0.056	0.010	0.027
72/12/09	13 50		0.270	0.480	0.060	0.013	0.025
73/01/21	09 15		0.380	1.150	0.150	0.019	0.035
73/02/03	14 40		0.294	0.540	0.086	0.020	0.035
73/03/03	09 45		0.310	0.860	0.110	0.020	0.035
73/04/07	14 00		0.081	0.500	0.019	0.008	0.020
73/04/21	08 30		0.050		0.120	0.012	0.035
73/05/05	08 25		0.024	0.540	0.014	0.009	0.030
73/05/20	14 10		0.013	0.690	0.038	0.009	0.025
73/06/24	09 40		0.042	0.520	0.026	0.019	0.045
73/07/22	09 20		0.039	0.400	0.035	0.006	0.037
73/08/26	14 30		0.042	1.600	0.054	0.022	0.040

STORET RETRIEVAL DATE 74/10/02

550941 L5550941
45 59 00.0 090 32 00.0
SPILLER CREEK
55 7.5 KENNEDY
T/BUTTERNUT LAKE
CO HWY A XING W SIDE OF LAKE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/04/25	18	10	0.234	1.100	0.120	0.033	0.046
72/10/14	14	20	0.160	1.006	0.126	0.022	0.066
72/11/12	09	25	0.115	0.730	0.024	0.009	0.025
72/12/04	14	20	0.330	0.420	0.050	0.011	0.024
73/01/21	09	30	0.420	1.150	0.189	0.030	0.055
73/02/03	15	20	0.340	1.150	0.044	0.019	0.040
73/03/03	10	05	0.378	0.500	0.060	0.018	0.035
73/04/07	14	10	0.115	0.520	0.022	0.005K	0.015
73/04/21	08	40	0.084	2.450	0.132	0.012	0.030
73/05/05	09	40	0.040		0.052	0.009	0.035
73/05/20	14	30	0.048	0.690	0.028	0.011	0.025
73/05/24	09	55	0.200	0.610	0.035	0.019	0.047
73/07/22			0.160	2.300	0.066	0.024	0.035
73/08/26	15	00	0.200	1.260	0.064	0.025	0.040

K VALUE KNOWN TO BE LESS
THAN INDICATED